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From: State and Private Forestry, Forest Health Protection, South Sierra Shared Service Area

Subject: Hazard tree assessment in Lower and Upper Pines Campgrounds, Yosemite Valley

On June 29, 2020, Yosemite National Park Forester Margaret O'Laughlin-Julson, Forest Service entomologist Beverly Bulaon and pathologist Martin MacKenzie made a tour of Lower and Upper Pines Campgrounds in Yosemite Valley, Yosemite National Park. The purpose of the visit was to examine recently fallen and dead trees in the campgrounds, assess probable causes, and discuss consequent management needed to prevent further loss and mitigate hazards for public safety. Although the campgrounds are currently closed to the public and immediate hazards already been treated, remaining tree conditions and recommendations for future management of campgrounds was discussed.

Field Observations

Yosemite National Park has a long history of land management that has significantly altered the structure and composition of the Valley floor. The cessation of grazing and Native American burning practices has allowed Valley conifer and shrub vegetation to proliferate from historically lower abundance. Areas that have become denser in numbers of individual stems, now are full of trees vying for limited space and resource. Competition effects are noticeable on overstory conifer trees: small canopy crowns at greater height, limited stem taper, and shallow root systems. The high density of trees had also provided shielding from strong winds typical in the Valley. This has resulted in skinny tall trees with small root plates.

Another issue that may have contributed to some green tree uprooting, particularly in Lower Pines campground was flooding. While small creek flows had significantly lessened around Curry Village campgrounds, weakening surrounding Ponderosa pines to bark beetle attack, the opposite occurred in sections of Lower Pine campground close to Happy Isles Loop Road. Clogged culverts or low spots in the ground allowed large areas of water to stagnate, soaking underground root systems (*see Figures 1-3*). Normally these areas would dry up by spring, but perpetual soggy conditions in combination with strong winds typical of the Valley was enough to topple trees that didn't have much holding root systems initially and possibly damaged with root disease.

***Figures 1-3**. 1. Clogged culvert creating flooded areas in Lower Pines campground. 2. Uprooted Ponderosa pine due to flooding and high winds. 3. Uprooted incense cedar next to large flooded hole at a campsite.*

Root rot studies conducted in Yosemite National Park show high infection rates, and multiple infection centers scattered in the Valley (Slaughter and Rizzo 1999); yet root disease was not frequently noted in our observations as a contributor of damage in the campgrounds. What we observed as a main cause for recently dead (ponderosa pine) and toppled green trees was recent drought effects that triggered bark beetle attack, and the subsequent removal of those dead trees for public safety. Exposed to strong Valley winds, the residual trees with high crown height and skinny stems were easily blown down or broken – primarily at the edges of new openings (*see Figure 4*).

Windthrown trees fell into two categories: those that tipped over and brought up root plates/ball with them, or those whose roots snapped and pulled out of the ground. After the stem was cut from the root plate/ball it frequently rotated back into the hole it previously vacated and left an upright stump with a normal orientation (*see Figure 5*). It was only in those trees where the roots had snapped and torn out of the ground that we could find evidence of root rot. Although rhizomorphs of *Armillaria* were infrequent, the rot pattern was consistent with this fungus which has been documented in the Valley. Some of the wind-blown trees easily failed where the root rot was present. The *Armillaria* rotted roots were frequently roots which had been previously growing *into* the direction of the wind that blew the trees over. Healthy roots, even very small ones, can withstand significant strain. Roots have an ability to withstand strain but not push back against a wind. Thus, if major roots on the windward side are rotted, the tree is unstable because those leeward roots cannot contribute to holding the tree in place when pushed.

***Figure 4**. Large opening created from dead tree removal. Opening facing towards Happy Isle Loop road. Note windthrown trees in the foreground.*

Figure 5. *Windthrown cedar which had righted its stump after the top had been removed. The stump's root plate is both small and intact, indicating that the tree had previously been in severe competition for growing space but roots were healthy enough to keep the root plate intact. Had the roots been rotted, they would have snapped and pulled out of the ground leaving the soil behind.*

That some wind thrown trees rotated about the root ball then pulled out of the ground still attached, indicates that majority of roots were still healthy and held soil together even though smaller than typical size (one to three times wider beyond the drip line is general rule). Though trees had been competing for growing space above and below ground, the nearby creek provided enough water that root systems didn't need to be expansive. In contrast the roots of few trees that failed due to root rot, failed to hold the root ball together that soil easily fell apart and loosened. These roots snapped and pulled out of the soil at the location of infection (*see Figure 6*). As noted earlier, rotted roots we observed were ones that had been previously growing into the prevailing winds.

Figure 6*. Uprooted tree with confirmed Armillaria root disease in Lower Pines campground. Note ripped roots and minimal soil on root plate.*

Summary

Pine mortality in Lower and Upper Pines campgrounds as well as throughout the Valley, were consequences of bark beetle infestations due to severe drought effects; in the campgrounds, residual green trees suddenly exposed to strong prevailing winds were much of the cause of recent blowdowns. While root rot contributed to some failures, it was not the overriding cause but should be investigated when tree failures occur as root diseases have been documented in several past incidents. When maintaining trees in campgrounds to have long endurance, opening dense tree groups in early seral stages to encourage greater live crown ratios and allowing maturing trees to adapt to wind stress would also help below-ground growth for more extensive root systems. Root plates observed of some windblown incense cedars and pines that had been previously growing in relatively crowded conditions kept root plates compact and instead encouraged height growth to break through dense overstory. The resulting structure makes trees highly unstable – not just against wind. This type of hardening treatment is often done in multiple phases to allow residual trees to acclimate and adjust. Thus, when forest openings are suddenly created, trees that have not adapted to wind-stress are at high risk for failure.

This visit highlights the complexities of protecting existing camping infrastructure while trying to maintain historical and natural resources and ironically, needs of public use increase to enjoy these features. Upkeep of older infrastructure is easy to overlook, but culverts in this case did critically contribute to weakening tree stability. Continual construction of road systems, trails, and general access for visitors may indirectly amplify environmental forces already occurring in the Valley. The ecological shift from historically oak woodlands to conifer-dominant forests has changed conservation strategies for land managers but increased public use adds to the complexity. The prevalence of root disease and continuing bark beetle mortality will need to be addressed when assessing campground conservation, as well as current stand structure and compositions. Managing for healthy forest conditions, public use and safety, and infrastructure maintenance is difficult when legacy of past actions affects current conditions. A review of vegetation management plans may need to be updated as more trees continue to be lost due to native or indirect disturbances, or Park configurations to accommodate public demand. FHP is happy to help providing additional insect and disease information, input regarding strategies around administrative sites, or assessment/monitoring of continuing forest health concerns.

If there are further questions regarding this report, please do not hesitate to contact us.

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Reference

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